AN OVERVIEW OF THE NAVY OCCUPATIONAL HEALTH INFORMATION MONITORING SYSTEM (NOHIMS)

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INFORMATION MONITORING SYSTEM (NOHIMS)

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INTRODUCTION

The Navy employs hundreds of thousands of workers (both civilian and military) who are scattered across the country, involved in a variety of diverse industrial operations, and exposed to multiple health risks from an array of chemicals and other agents. In order to provide a safe and healthful work environment for these workers as required by the Occupational Safety and Health Act of 1970, the Navy has developed the Navy Occupational Health Information Monitoring System (NOHIMS) and is currently implementing a pilot system at the Naval Air Rework Facility (NARF), San Diego. NOHIMS has been designed to insure that (1) all individuals exposed to hazardous agents within a facility are identified, (2) all exposed individuals are given periodic examinations, (3) examinations include those tests and procedures needed for prudent monitoring, (4) the environmental information which led to the decision to monitor or not to monitor an individual is recorded, and (5) sufficient data for epidemiological studies are retained in a readily accessible form.

SYSTEM DESIGN

In order to provide the information needed to coordinate the components of the Navy's occupational health program, NOHIMS utilizes a database consisting of several types of data entered into the system on an ongoing basis and a set of reference tables that makes it possible to interpret the significance of a particular element of data. For example, the measured amount of a contaminant found in the work place needs to be compared to a table containing the allowable exposure levels for various substances to determine if the measured exposure level presents a health risk to workers. Similarly, the result of a laboratory test on a patient needs to be referred to the range of normal values for that test to determine if the patient's result is abnormal. Thus, raw data supplied to NOHIMS need to be placed in a context that can provide a reference for appropriate interpretation and evaluation. Finally, it should be noted that these tables are dynamic because they are readily modified. Tables can be altered to reflect any changes in recognized standards or to add entirely new categories of data.

Once raw data have been compared to standard reference points, it becomes possible to compile various reports and to exchange this information on a timely basis. This fundamental flow of information through NOHIMS from the collection or capture of raw data to the interpretation and evaluation of these data and their compilation in a report to users is shown in Figure 1.
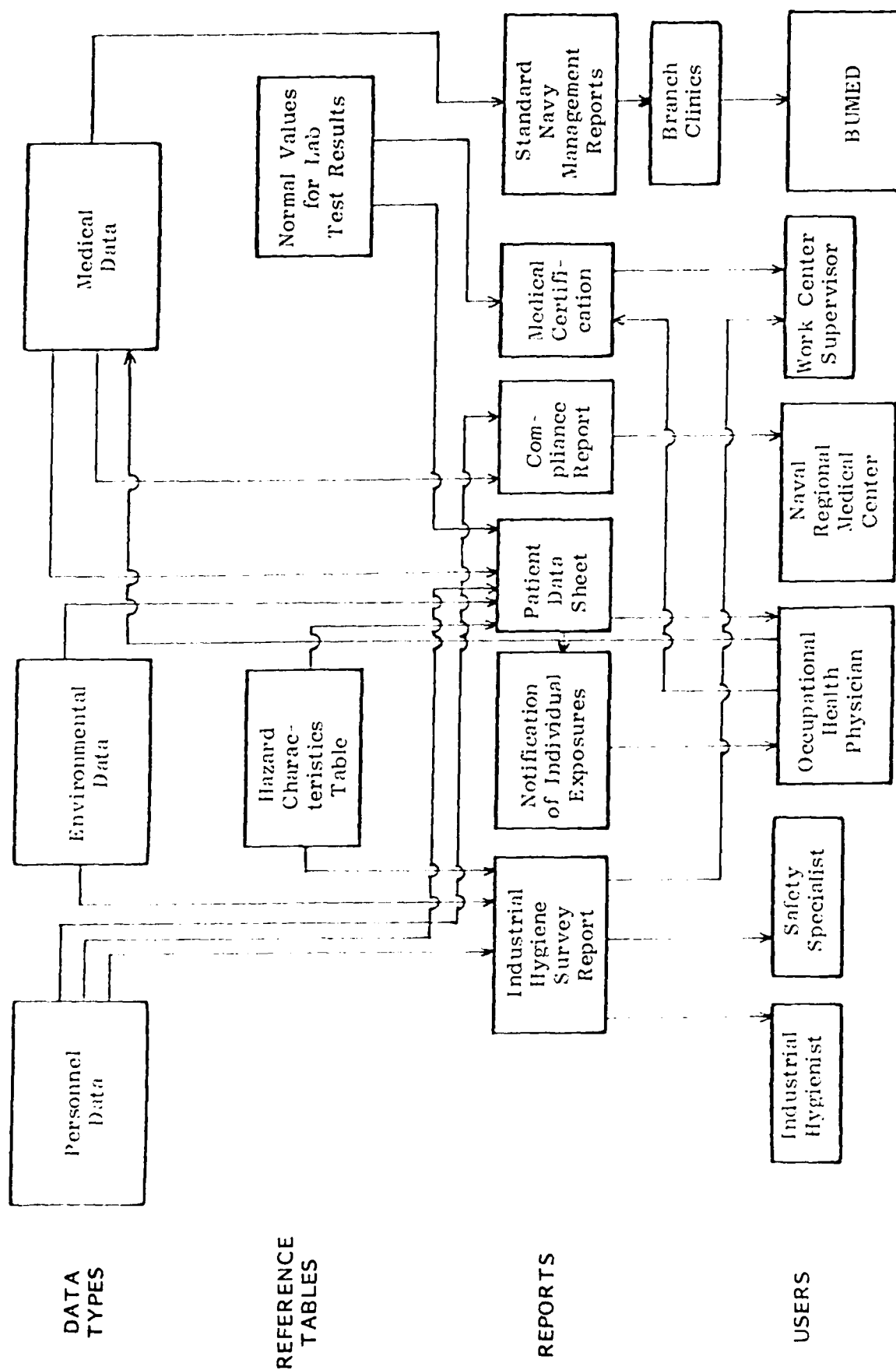
Figure 1. The Navy Occupational Health Information Monitoring System (NOHIMS).

DATA
TYPES

REFERENCE
TABLES

REPORTS

USERS

Personnel Data

Environmental Data

Medical Data

Hazard Characteristics Table

Normal Values for Lab Test Results

Industrial Hygiene Survey Report

Notification of Individual Exposures

Patient Data Sheet

Compliance Report

Medical Certification

Standard Navy Management Reports

Branch Clinics

BUMED

Industrial Hygienist

Safety Specialist

Occupational Health Physician

Naval Regional Medical Center

Work Center Supervisor

Figure 1 shows that there are three basic types of data that comprise the NOHIMS database---personnel data (worker histories), environmental data (industrial activities, work place environments, and hazards), and medical data (medical histories, physical exam results, and the results of laboratory tests). The reference tables utilized by NOHIMS to interpret and evaluate a particular element of data are the table of Hazard Characteristics and a table containing the range of normal values for lab test results.

NOHIMS provides six key reports. The first of these, the Industrial Hygiene Survey Report, is generated from both personnel and environmental survey data with input from the Hazard Characteristics table. The three major users of this report are the industrial hygienist, the safety specialist, and the work center supervisor. When workers have been exposed to a hazardous substance or agent, NOHIMS notifies the occupational health physician of individual exposures in a second reporting function. The third report, the Patient Data Sheet, is a summary generated from the patient's medical history, pertinent recent medical data, personnel data, and exposure data, with additional input from the Hazard Characteristics table and the table containing the range of normal values for lab test results. This report is prepared for the occupational health physician before each scheduled patient visit, but may also be requested on demand for walk-in or emergency visits.

In a fourth reporting function facilitated by NOHIMS, the occupational health physician, after examining a patient, provides medical certification that the worker is fit or unfit to perform his or her job. This certification is sent to the work center supervisor where the employee works. The fifth report prepared by NOHIMS, a monthly Compliance Report, utilizes personnel data and medical encounter data to monitor compliance with the required medical surveillance program. This report is forwarded to the Naval Regional Medical Center. Finally, NOHIMS can produce standard Navy management reports for Navy branch clinics and the Bureau of Medicine and Surgery (BUMED) and has the capability for generating additional reports or modifying the ones currently produced.

STRUCTURE AND CONTENT OF NOHIMS DATABASES

NOHIMS consists of two subsystems: (1) an industrial component and (2) a medical information component. The industrial component performs all the functions required to identify individuals at risk and to insure that they are examined periodically. Therefore, the industrial subsystem contains the personnel and environmental data. The medical information component consists of COSTAR---the Computer Stored Ambulatory Record system. Each of these two components of NOHIMS can operate as a stand-alone system. Or, they can function as a single, integrated system because both components use the same system conventions wherein users interact with the database at increasing levels of specificity by making choices from a hierarchical series of option

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menus. In addition, both components incorporate extensive user help, aids, and explanation techniques. These features make NOHIMS "user friendly" and eliminate the need for professional ADP personnel to use the system.

A presentation of the types of information contained in the NOHIMS database is shown in Figure 2. In this figure, personnel data (worker histories) and environmental data (industrial activities, work place environments, and hazards) have been subsumed under the more general label of industrial data on the worker population. Industrial data are transmitted as needed to the medical data portion of the NOHIMS database via the database access pathway. In order to assure the security of medical data on the patient population, the industrial component of NOHIMS cannot access medical data. Only those elements of medical data required by the industrial facility are extracted and cross-referenced to appropriate data elements in the industrial data portion of the database.

Figure 3 shows a display of the first-level menu in NOHIMS which provides the user with a choice of nine primary system options. The first five of these options concern system functions performed on patient data—registering and scheduling patients, and entering, displaying, and printing medical data. The sixth option allows the user to generate standard or individually tailored reports. The seventh option is used by the systems manager to maintain and modify certain aspects of NOHIMS operation. Option 8, the mailbox option, allows NOHIMS users to leave messages for each other in the information system. These first eight options are all COSTAR functions. However, the ninth and last primary system option is different. It takes the user to a second-level menu which displays the six occupational health information options that are available, as displayed in Figure 4. Selection of any second-level option in NOHIMS takes the user to a third level of choices and so on until the user reaches the exact level of ail needed for interacting with the system.

NOHIMS FLEXIBILITY AND ADAPTABILITY

The omnibus cross-referencing feature of NOHIMS is one of the main characteristics of the system that assures its maximum flexibility and adaptability. Figure 5 depicts the pervasive multiple cross-referencing of data elements in the industrial data portion of the NOHIMS database. The NOHIMS file structure provides pointers from one type of data element to another so that it is possible to track workers by social security number through their entire work history and medical encounters. Thus it is possible to retrieve all of the environments in which an employee has worked, the industrial activities employing the worker, the dates and time spent in each work environment, hazards existing in these various work places, protective gear issued to the worker, levels of exposure to hazardous substances and agents, medical surveillance required for the worker, plus medical history and the results of physical exams and laboratory tests.

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ACTIVITIES DATA

PERSONNEL DATA

ENVIRONMENT DATA

SURVEY DATA

HAZARD DATA

MAINTENANCE

Figure 4.   Occupational Health Information Options
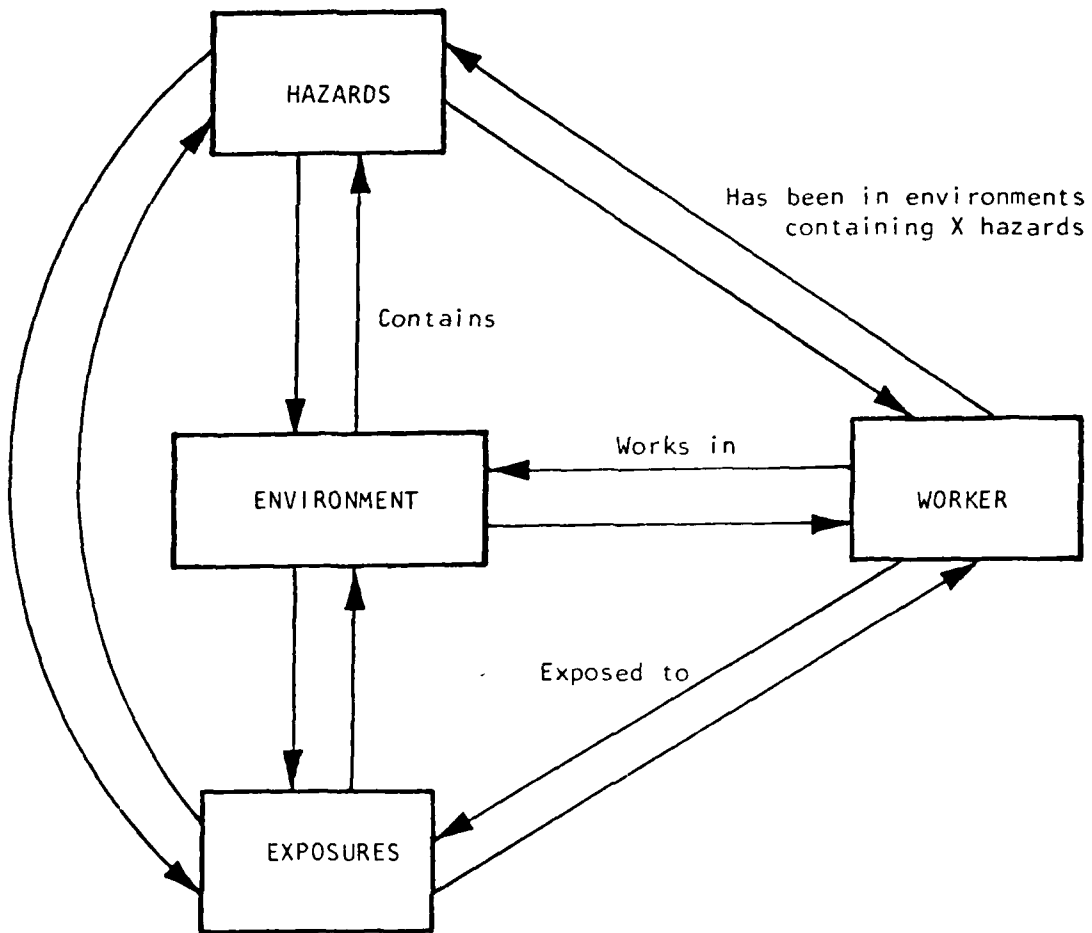in NOHIMS (a Second-Level Menu).

Figure 5. The Pervasive Multiple Cross Referencing of Data Elements in the NOHIMS Database.

Because of the vast flexibility inherent in the design of NOHIMS and its extensive cross-referencing capability, it is possible to ask a virtually unlimited number of questions of the system. Some examples of the kinds of questions that NOHIMS is capable of answering are the following.

- What hazards are contained in a particular environment?

- For a particular hazard*, what environments contain this hazard?

- For a particular environment, have workers there been exposed to any hazards? If so, who was exposed? To which hazards? When? How much? Does the amount of the exposure exceed the allowable level for that substance?

- Which environments have experienced exposures of a particular hazardous substance? When? In which of these environments did the exposure exceed the allowable level for that substance?

- In what environments has a particular employee worked? Did any of these environments contain hazards? If so, which hazards? Has the worker been exposed to any of these hazards at a level that exceeded the allowable level? If so, when?

- For a particular environment, what employees work there?

- For a worker exposed to a hazardous substance, what are the values of a particular lab test over time used to monitor that worker's state of health?

- What workers have been exposed to, say, asbestos in the last year? In what environments were they working when exposed?

- What is the incidence of, say, dermatitis in a particular work place environment over time (to be related to a list of contaminants or hazards present in that environment at different times)?

- What is the incidence of, say, respiratory ailments among all patients seen at a particular branch clinic during the past month compared to the incidence in the preceding 12 months (to be related to exposure data and to seasonal variations)?

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*
A hazard can be identified by just a few leading characters of its name or by a few leading characters of any of its synonyms.

The list of questions just enumerated certainly is not exhaustive, but it is illustrative of what inquiries can be posed to NOHIMS. Many additional queries are possible.

Other features in addition to the omnibus cross-referencing capability also contribute to making NOHIMS flexible and adaptable. The organization of each activity is defined in NOHIMS according to hierarchical organizational levels regardless of how scattered geographically they may be or how large or small the activity may be. Activities do not have to change how they do business to mesh with NOHIMS requirements. Each activity may use its own organizational names, acronyms, and codes, and NOHIMS will keep track of it all. If the organization of an activity changes, NOHIMS can be updated to reflect the reorganization, while not forgetting the time period covered by the previous organization. Thus, for example, work shops may be combined or a new shop may be added, and NOHIMS will keep track of this organizational history. Furthermore, a large array of entities may be defined as industrial activities, and a wide variety of work places, occupations, or events may be defined as an environment.

RETRIEVING DATA: NOHIMS REPORTS AND THEIR USERS

There are multiple users of NOHIMS data and reports as was shown earlier in Figure 1. These users are industrial hygienists, safety specialists, occupational health care providers, work center supervisors, managers of Navy occupational safety and health programs, and finally, medical researchers and epidemiologists.

The Industrial Hygiene Survey Report (IHSR) is of particular value to the industrial hygienists. During a routine resurvey of a work area, the IHSR can serve as a guide or reference. The hygienists would know what contaminants to expect and be able to determine immediately what contaminants had been introduced recently. Special attention then could be given to the procedures used in handling the new materials. In addition, the IHSR would provide the hygienists with a list of personnel said to be assigned to the area of the survey. This list can be used to verify that information and to check on the medical certification of the employees.

The IHSR is also of special interest to the safety specialists. Information contained in this report, for example, would provide a cross check between worker training and the handling of hazardous materials.

The occupational health physician receives notification of individual exposures from NOHIMS. For those workers requiring medical surveillance, NOHIMS generates a Patient Data Sheet before each scheduled visit. The Patient Data Sheet is a summary of the patient's medical history, pertinent

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recent medical data, exposure data, and the type of medical surveillance required. An example of a Patient Data Sheet for a hypothetical patient is shown in Figure 6. When the patient arrives at the branch clinic, the occupational health nurse initiates the taking of an occupational health history, which the occupational health physician completes during the patient encounter. After the encounter, the physician certifies whether or not the patient is medically qualified to work in a particular work place. NOHIMS also can be used to generate in advance any required lab chits used by the occupational health technician in performing lab tests during a patient visit.

The work center supervisor constantly monitors the work situation, sending new workers or workers with new assignments to a Navy branch clinic for medical certification and to training sessions to learn proper work procedures. The work center supervisor receives notice of medical certification from NOHIMS and obtains information regarding the presence of hazardous substances in the work place through the Industrial Hygiene Survey Report.

The medical data portion of the NOHIMS database contains all of the information needed to prepare standard Navy management reports for each Navy branch clinic, with copies forwarded to BUMED. A monthly Compliance Report, based on personnel and medical encounter data, informs manager at the Naval Regional Medical Center of the proportion of workers in .e region who are in compliance with their required medical surveillan In addition, as the need may arise, specially requested reports can b(epared for managers of Navy occupational safety and health programs using .ie versatile features of the NOHIMS report generator.

Finally, on either a formal or informal basis there is a medical research function which first monitors illness and the laboratory results of medical examinations in order to detect any trend toward increased illness among groups of employees. Upon the identification of any such trend, demographic and environmental correlates are investigated in an attempt to identify causal factors. Consequently, the NOHIMS database is a rich source of valuable data for medical researchers and epidemiologists.

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                          PATIENT DATA SHEET
                            -ANNUAL EXAM-
                             11 MAY 1982


NAME:   JOHNSON,KATHY L
████   ████████           ████  ███  ███
SEX:    FEMALE
AGE:    23                ████████  █ █ ██

         WORK ENVIRONMENT          HRS/WEEK      JOB TITLE
   -------------------------------------------------------------------
   12/1/81  LOADING DOCK W. OF BLDG.0094  40     SHIPPING CLERK
   6/19/81  BLDG:0094   SHOP:36112  40           MAIL AND FILE CLERK
   -------------------------------------------------------------------


                  * * *  WORK PLACE HAZARDS  * * *
                   TIME WEIGHTED AVERAGE (TWA)           CEILING (STEL)
              ---------------------------------     ---------------------
              EXPOSURE     CURRENT    PERCENT OF     EXPOSURE    CURRENT
CONTAMINANT   LEVEL        TLV        CURRENT TLV    LEVEL       TLV
-----------   --------     -------    ----------     --------    -------
AMMONIA       20 PPM       25 PPM     80
XYLENE        17 PPM       100 PPM    17
   -------------------------------------------------------------------


                  * * *  PATIENT SUMMARY  * * *

---------------------------- REASON FOR VISIT ----------------------------

6/19/81   PREPLACEMENT EXAM                                    SMITH,M

------------------------------- PROBLEMS -------------------------------
MINOR
  HX, TOBACCO USE                                      6/19/81 SMITH,M

----------------------------- PHYSICAL EXAM -----------------------------

TEMPERATURE              98.4                          6/19/81 SMITH,M
PULSE                    80                            6/19/81 SMITH,M
RESPIRATORY RATE         20                            6/19/81 SMITH,M
BLOOD PRESSURE           112/72 LEFT ARM               6/19/81 SMITH,M
HEIGHT                   63                            6/19/81 SMITH,M
WEIGHT                   104                           6/19/81 SMITH,M

------------------------------ PROCEDURES ------------------------------

6/19/81   CHEST X-RAY                                          SMITH,M
             NORMAL
6/19/81   PULMONARY FUNCTION TESTS                             SMITH,M
             FEV 1.0: 5.1 L/M (98% PRED)
             FVC: 3.0 L (103% PRED)

------------------------------ DISPOSITIONS ------------------------------

6/19/81   SMITH,M         MEDICALLY QUALIFIED FOR JOB PLACEMENT

   -------------------------------------------------------------------
```

Figure 6.   Example of a Patient Data Sheet
Generated by NOHIMS.

* * *   HEALTH EFFECTS OF WORK PLACE HAZARDS (SUMMARY)   * * *

KIDNEY DAMAGE
BLOOD CHANGES (SUSPECT)
LIVER DAMAGE
CNS NARCOSIS
SKIN
 IRRITATION
 BURNS
MUCOUS MEMBRANES (EYES, NOSE, ORAL CAVITY)
 IRRITATION
 INJURY
RESPIRATORY TRACT
 IRRITATION
 CHEST CONSTRICTION
 PULMONARY EDEMA

----

* * *   MEDICAL SURVEILLANCE APPROACH RECOMMENDED   * * *

HISTORY, ESPECIALLY FOR:
  PERSONAL HISTORY OF:
    ALCOHOL INGESTION
    EXPOSURE TO IRRITANTS
    HOBBIES INVOLVING EXPOSURE TO AMMONIA OR OTHER IRRITANTS
    EXPOSURE TO CHEMICALS CAUSING DAMAGE TO:
     KIDNEYS
     LIVER
  WORK HISTORY OF:
    PREVIOUS EXPOSURE TO AMMONIA OR OTHER IRRITANTS
    EXPOSURE TO IRRITANT CHEMICALS
    EXPOSURE TO CHEMICALS AFFECTING:
     KIDNEYS
     LIVER
  PAST MEDICAL HISTORY AND REVIEW OF SYSTEMS:
    KIDNEY DISEASE
    LIVER DISEASE
    ESP. CIRRHOSIS OF THE LIVER
    SKIN
     DISEASES
     IRRITATION
    MUCOUS MEMBRANES (EYES, NOSE, ORAL CAVITY)
     DISEASES
     DISORDERS
     SYMPTOMS
    RESPIRATORY TRACT
     DISORDERS
     SYMPTOMS
    NEUROLOGICAL DISORDERS/SYMPTOMS
     CONFUSION
     IRRITABILITY

Figure 6.   Example of a Patient Data Sheet
Generated by NOHIMS   (Cont.).

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PHYSICAL EXAMINATION, ESPECIALLY:
   SKIN
     DISEASE
     IRRITATION
   MUCOUS MEMBRANES (EYES, NOSE, ORAL CAVITY)
     DISEASE
     IRRITATION
   RESPIRATORY TRACT
     DISEASE
     IRRITATION
   LIVER
     HEPATOMEGALY
     DISEASE
   KIDNEYS
     DISEASE
   NEUROLOGICAL
     DISEASE
     TOXICITY

TESTS AND PROCEDURES:
   COMPLETE BLOOD COUNT WITH
     DIFFERENTIAL LEUKOCYTE COUNT
   KIDNEY FUNCTION TESTS:
     BUN AS CLINICALLY INDICATED
     SERUM CREATININE AS CLINICALLY INDICATED
   URINALYSIS, COMPLETE
   PULMONARY FUNCTION TESTS:
     FORCED EXPIRATORY VOLUME (FEV 1.0)
     FORCED VITAL CAPACITY (FVC)
   CHEST X-RAY AS CLINICALLY INDICATED
```

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* * * COMMENTS * * *

AMMONIA IS AN IRRITANT OF THE EYES, NOSE, THROAT AND SKIN. SYMPTOMS
RANGE FROM MILD TO MODERATE IRRITATION AT LOW CONCENTRATIONS. EXPOSURE
TO AND INHALATION OF HIGHER CONCENTRATIONS CAUSE SEVERE CORNEAL
IRRITATION, DYSPNEA, BRONCHOSPASM, CHEST PAIN, AND POTENTIALLY FATAL
PULMONARY EDEMA. MEDICAL SURVEILLANCE CENTERS ON THE SYSTEMS INVOLVED,
AND INCLUDES A BASELINE CHEST X-RAY AND PERIODIC PULMONARY FUNCTION
TESTS.
****

XYLENE IS A COLORLESS LIQUID USED AS A SOLVENT. IT HAS NUMEROUS
EFFECTS. THE VAPOR IS AN IRRITANT OF THE MUCOUS MEMBRANES (EYES, NOSE,
ORAL CAVITY) AND SKIN. HIGHER CONCENTRATIONS CAN PRODUCE GASTRO-
INTESTINAL SYMPTOMS (NAUSEA, VOMITING, ABDOMINAL PAIN) AND CNS SYMPTOMS
(DIZZINESS, EXCITEMENT, DROWSINESS, INCOORDINATION, ATAXIA). AT VERY
HIGH CONCENTRATIONS RESPIRATORY EFFECTS (PULMONARY EDEMA) MAY RESULT.
ALSO SOME HEMATOPOIETIC DEPRESSION AS WELL AS LIVER AND KIDNEY
EFFECTS HAVE BEEN NOTED. MEDICAL SURVEILLANCE EMPHASIS IS ON THE
SYSTEMS AFFECTED. TESTS AND PROCEDURES INCLUDE BASELINE CHEST X-RAY,
PERIODIC LIVER FUNCTION TESTS, CBC, AND URINALYSIS. IF SEVERE
EXPOSURE IS SUSPECTED, SEE EXTENSIVE COMMENTS SECTION.
****

Figure 6.   Example of a Patient Data Sheet
            Generated by NOHIMS (Cont.).

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Navy employs hundreds of thousands of workers (both civilian and military) who are scattered across the country, involved in a variety of diverse industrial operations, and exposed to multiple health risks from an array of chemicals and other agents. In order to provide a safe and healthful work environment for these workers as required by the Occupational Safety and Health Act of 1970, the Navy has developed the Navy Occupational Health Information Monitoring System (NOHIMS) and is currently implementing a pilot system at the Naval Air

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